CLAIMS

1. A polishing apparatus comprising:

a polishing section configured to polish a substrate;

a measurement section configured to measure a thickness of a film formed on the substrate;

an interface configured to input a desired thickness of a film formed on a substrate to be polished;

a storage device configured to store polishing rate data on at least one past substrate therein; and

an arithmetic unit operable to calculate a polishing rate and an optimal polishing time based on the polishing rate data and the desired thickness by using a weighted average method which weights the polishing rate data on a lately polished substrate.

2. A polishing apparatus comprising:

a polishing section configured to polish a substrate;

a measurement section configured to measure a thickness of a film formed on the substrate;

an interface configured to input a desired thickness of a film formed on a substrate to be polished;

a storage device configured to store polishing rate data on at least one past substrate therein; and

an arithmetic unit operable to calculate a polishing rate and an optimal polishing time including a margin so as not to excessively polish a subsequent substrate based on the desired thickness and a range of a variation of the polishing rate data.

3. A polishing apparatus comprising:

a polishing section configured to polish a substrate;

a measurement section configured to measure a thickness of a film formed on the substrate;

an interface configured to input a desired thickness of a film formed on a substrate to be polished;

a storage device configured to store polishing rate data on at least one past substrate therein;

an arithmetic unit operable to calculate a polishing rate and an optimal polishing time based on the polishing rate data and the desired thickness;

a receiver configured to receive a calibration substrate having a known thickness of a film formed thereon; and

a transferring section configured to transfer the calibration substrate from said receiver to said measurement section.

4. A polishing apparatus comprising:

a polishing section configured to polish a substrate having a plurality of laminated films including an upper layer and a lower layer;

a measurement section configured to measure a thickness of a film formed on the substrate;

an interface configured to input a desired thickness of a film formed on a substrate to be polished; and

an arithmetic unit operable to calculate a polishing rate for at least one of the plurality of laminated films and an optimal polishing time for at least one of the plurality of laminated films based on the desired thickness and a ratio of polishing rates for the upper layer and the lower layer or on a signal from said measurement section.

5. A polishing method comprising:

measuring a thickness of a film formed on a substrate;

inputting a desired thickness of a film formed on a substrate to be polished;

storing polishing rate data on at least one past substrate in a storage device;

calculating a polishing rate and an optimal polishing time based on the polishing rate data and the desired thickness by using a weighted average method which weights the polishing rate data on a lately polished substrate; and

polishing a subsequent substrate for the optimal polishing time.

6. The polishing method as recited in claim 5, further comprising calibrating said measuring at a predetermined frequency with use of a calibration substrate having a known thickness of a film formed thereon.

7. A polishing method comprising:

measuring a thickness of a film formed on a substrate;

inputting a desired thickness of a film formed on a substrate to be polished;

storing polishing rate data on at least one past substrate in a storage device;

calculating a polishing rate and an optimal polishing time including a margin so as not to excessively polish a subsequent substrate based on the desired thickness and a range of a variation of the polishing rate data; and

polishing the subsequent substrate for the optimal polishing time.

8. The polishing method as recited in claim 7, wherein after the optimal polishing time is calculated based on a polishing result of a first substrate in a lot, a subsequent substrate in the lot is polished for the optimal polishing time.

9. A polishing apparatus comprising:

a polishing section configured to press a substrate against a polishing surface so as to bring the substrate into sliding contact with said polishing surface to polish the substrate;

a first measurement device configured to measure a thickness of a film formed on the substrate;

a second measurement device configured to monitor at least one of parameters of a depth of a groove formed in a surface of said polishing surface, a roughness of the surface of said polishing surface, a temperature of the surface of said polishing surface, and a thickness of said polishing surface; and

a controller operable to calculate an optimal polishing time for the substrate based on a correlation between a change of a polishing rate and the at least one of parameters, a monitored value of the at least one of parameters, and measured values of the thickness of the film before and after polishing.

10. The polishing apparatus as recited in claim 9, wherein the change of the polishing rate in the correlation is defined as a change of a polishing rate until a new polishing surface is replaced.

11. The polishing apparatus as recited in claim 9, wherein said first measurement device comprises at least one of an optical sensor, an eddy-current sensor, and an optoacoustic sensor.

12. The polishing apparatus as recited in claim 9, wherein said polishing section has a dresser for conditioning said polishing surface,

wherein said second measurement device comprises a measurement device having a light source for applying light to a surface of composition of said dresser and a detector for detecting light reflected from the surface of said composition of said dresser to monitor the thickness of said polishing surface.

13. The polishing apparatus as recited in claim 9, wherein said second measurement device comprises a detector for detecting an amount of abrasion of said polishing surface by using a laser and a subtracter for the amount of abrasion of said polishing surface from an initial depth of said groove of said polishing surface to calculate the depth of said groove of said polishing surface.

14. The polishing apparatus as recited in claim 9, further comprising:

a third measurement device for measuring at least two points on a polished substrate to detect irregularities of the polished substrate; and

an alarm device operable to issue an alarm when an amount of the irregularities is more than a preset value.

15. The polishing apparatus as recited in claim 9, further comprising a cleaning liquid supply mechanism configured to supply a cleaning liquid that has been adjusted in temperature to the surface of said polishing surface.

16. The polishing apparatus as recited in claim 15, wherein said polishing surface is formed by a polishing pad or a fixed abrasive.

17. A polishing method comprising:

monitoring at least one of parameters of a depth of a groove formed in a surface of a polishing surface, a roughness of the surface of the polishing surface, a temperature of the surface of the polishing surface, and a thickness of the polishing surface;

calculating an optimal polishing time for a substrate based on a correlation between a polishing rate and the at least one of parameters; and

pressing the substrate against the polishing surface so as to bring the substrate into sliding contact with the polishing surface to polish the substrate for the optimal polishing time.

18. The polishing method as recited in claim 17, further comprising recording a relationship between a polishing rate until a new polishing surface is replaced and the at least one of parameters to obtain the correlation between the polishing rate and the at least one of parameters.

19. The polishing method as recited in claim 18, wherein said recording comprises producing an approximation formula of a polynomial or a step function representing a correlation between the at least one of parameters and the polishing rate,

wherein said calculating comprises substituting a monitored value of the at least one of parameters for the approximation formula.

20. The polishing method as recited in claim 17, wherein the roughness of the surface of the polishing surface is represented by at least one of maximum peak height (Rb), maximum valley depth (Rv), maximum height (Rz), mean height (Rc), total height of profile (Rt), arithmetical mean roughness (Ra), root mean square height (Rq), skewness (Rsk), kurtosis (Rku), mean width (RSm), root mean square slope (RΔq), material ratio (Rmr(c)), profile section height difference (Rδc), relative material ratio (Rmr), and ten-point mean roughness (Rzjis).

21. The polishing method as recited in claim 20, wherein the roughness of the surface of the polishing surface is measured by a contact-type surface roughness measurement device or a non-contact-type surface roughness measurement device.

22. The polishing method as recited in claim 17, further comprising:

measuring a thickness of a film formed on the substrate by a film thickness measurement device provided in a polishing table having the polishing surface; and

modifying the polishing rate based on a change of a measured value of said measuring.

23. The polishing method as recited in claim 17, further comprising:

measuring a thickness of a film formed on the substrate after said pressing to detect excessive polishing or insufficient polishing; and

modifying the polishing rate based on the excessive polishing or the insufficient polishing detected by said measuring.